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Original Communication

Suicidal poisoning in Southern India: Gender differences

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Abstract

Poisoning is an important health hazard and one of the leading causes of morbidity and mortality worldwide. Poisoning is one of the preferred means of committing suicide among males and females in India. A five year retrospective study from January 2000 to December 2004 was conducted at the Department of Forensic Medicine & Toxicology, Kasturba Medical College, Manipal, to understand the magnitude and pattern of suicidal poisoning deaths among males and females in Southern India. During this period, a total of 137 cases of suicidal poisoning related deaths were autopsied. Males were predominantly affected (male:female 2.8:1).

Maximum victims of suicidal poisoning mortalities were in their 3rd decade. Mean age for males and females was 40.5 years and 34.4 years, respectively. 27.8% of females and 10.9% males were suffering from depression. Preference for organophosphates was relatively more in males when compared to females, who preferred zinc phosphide, carbamates and medicinal agents. Suicidal poisoning was commonly encountered during afternoon hours in females. Males usually consumed poison during evening and late night hours. Maximum male mortalities were noted during second quarter of the year in contrast to first quarter in females. This paper examines the difference in pattern of suicidal poisoning among males and females to identify population at risk, and understand the problem status among both genders.

Keywords: Suicide; Poisoning; Organophosphates; Depression; Seasonality; Mortality

1. Introduction

The pattern of suicidal deaths can reflect the prevailing social set up and psychological mindset of the inhabitants of a region. Self harm (intentional self-injury) is a complex behaviour that can be thought as a maladaptive response to acute and chronic stress at a time when an individual fails to get out of the stress. Suicide behaviour, pattern and rates differ in various populations and culture. India ranks 10th in world with a suicide rate of 9.74 per lakh population.[1] The choice of method used to commit suicide depends on availability of means, knowledge about lethal effectiveness, victim's motivation and intent. A number of chemical substances have been developed to save and improve the agricultural yield. These agrochemicals agents meant for the benefit of man sadly have grown in reputation as a popular means of self-destruction all over the world. India is predominantly an agricultural nation, where these agrochemicals are available in plenty. Poisoning is the preferred means of committing suicide among males and females in India.[2–4]

Males and females differ from each other in their genetic make up, physical characteristics, and also the psychological mindset. They react to different circumstances differently, have different priorities, and make different choices in life. Although gender based differences in suicidal poisoning are well known, the issue has rarely, if ever, been addressed. Target population identification has always been the mainstay of preventive measures. This paper

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examines the difference in pattern of suicidal poisoning among males and females to understand the problem status separately for both sexes in this part of rural India.

Manipal is a rural township situated in the Udupi district of coastal Karnataka, Southern India, and Kasturba Hospital is the apex teaching hospital of Kasturba Medical College, Manipal. The aims of the study are to describe the gender differences with regard to pattern and trends of suicidal poisonings and identify population at risk in this part of the country, so that probable preventive measures can be suggested and taken up accordingly.

2. Materials and methods

Autopsy or postmortem examination is imperative when death is sudden, unexpected, suspicious or unnatural. In India, all poisoning deaths are recorded as unnatural and autopsy is performed. Toxicological analysis is an integral part of autopsy in suspected and known poisoning deaths to identify the poison responsible, for which relevant viscera, blood and urine are sent to Regional Forensic Science Laboratories (RFSL) for chemical analysis.

This retrospective research was carried out in the Department of Forensic Medicine & Toxicology, Kasturba Medical College, Manipal. All poisoning cases where manner was found to be suicidal as per police investigations and autopsy findings were included in the study. The study included 137 suicidal poisoning deaths autopsied at the aforementioned centre between January 2000 and December 2004. A detailed profile was made based on autopsy records and information furnished by the police in inquest papers. Identification of the poison responsible for the fatal outcome was based on the chemical analysis reports from the RFSL.

Available data were separately analysed for males and females, and compared. Gender was taken as the main observed variable and the data that was registered in a database, was analysed for other variables (age, religion, preferred poison, time and month of consumption, etc.) in relation to gender using Microsoft Excel and statistical programme for social sciences (SPSS) version 11.0. Gender based differences for these variables are discussed.

3. Results

A total of 762 autopsies were conducted in our mortuary between January 2000 and December 2004. Deaths due to suicidal poisoning constituted 17.9% (n= 137) of the total autopsied cases and remained the most common cause of suicidal mortalities during the study period. There was a decline in suicidal poisoning mortalities during the study period (Table 1). Males outnumbered females. 73.7% victims ($n = 101$) were males and 26.3% ($n = 36$) females; male–female ratio being 2.8:1.

The age of the male victims ranged from 16 to 82 years, while their female counterparts were aged between 16 and 68 years. Mean age for males and females was 40.5 years and 34.4 years, respectively. Among males and females, maximum suicidal poisoning mortalities were noted in 20–29 years age group (3rd decade), after which a gradual decline in suicidal poisoning was evident. Third to fifth decades were the most affected age groups, together accounting for nearly 70% of the total suicidal poisoning in both males and females. In both males and females, no suicidal poisoning victim was aged below 16 years. Comparative analysis reveals females to be particularly vulnerable during 2nd, 3rd, and 6th, and males in 4th, 5th, and 7th decade onwards (Fig. 1). Based on preliminary police investigation into suicides, 27.8% ($n = 10$) of total female victims, and 10.9% ($n = 11$) of the total male victims were suffering from depression. Only four victims (three males and one female) were seeking medical advice at the time of incident. 86.1% of the male victims ($n = 87$) were Hindus, followed by 11.9% Christians ($n = 12$) and 2% Muslims ($n = 2$). Among females, 88.9% victims were Hindus ($n = 32$) followed by Muslim and Christian females, 5.6% each ($n = 2$) (Fig. 2).

Table 1
Year-wise distribution of suicidal poisoning mortalities

Year	Autopsies conducted	Suicidal poisoning	Percentage (%)
2000	163	38	23.3
2001	199	35	17.6
2002	158	27	17.1
2003	113	19	16.8
2004	129	18	13.9
Total	762	137	17.9

Agrochemicals were the preferred agents with organophosphates alone responsible for maximum suicidal mortalities among males ($n = 83$) and females ($n = 21$). Zinc phosphide and carbamates were next to follow responsible for 3.9% and 3% suicidal mortalities in males and 11.1% and 5.6% mortalities in females, respectively. No male mortality was reportedly related to medicinal agents, however drug overdose was the cause of suicidal poisoning deaths in 11.1% ($n = 4$) females (Fig. 3). Medicinal agents used included sedatives, anti-depressants and anti-psychotics (barbiturates, phenothiazines and chlorpromazine). Other agents included glyphosate herbicide, kerosene, copper sulphate and cardiac glycosides in females and parquat, copper sulphate, phenol, cardiac glycosides in males. The use of organophosphates, that was the preferred agent in suicidal poisoning in both males and females, was analysed for three phases of life viz. young (less than 25 years), middle aged (between 26 and 50 years), old and elderly (more than 51 years). Preference for organophosphates amongst males was fairly uniform in all three groups, while females aged more than 51 years preferred organophosphate compounds as a means of suicide (Fig. 4).

Time of consumption of poison was known in 72% males and 50% females. In both males and females, maximum (more than 3/4th) mortalities occurred between 12 noon and midnight. Females had a relative preference for morning (6 am to 12 noon) and afternoon hours (12 noon

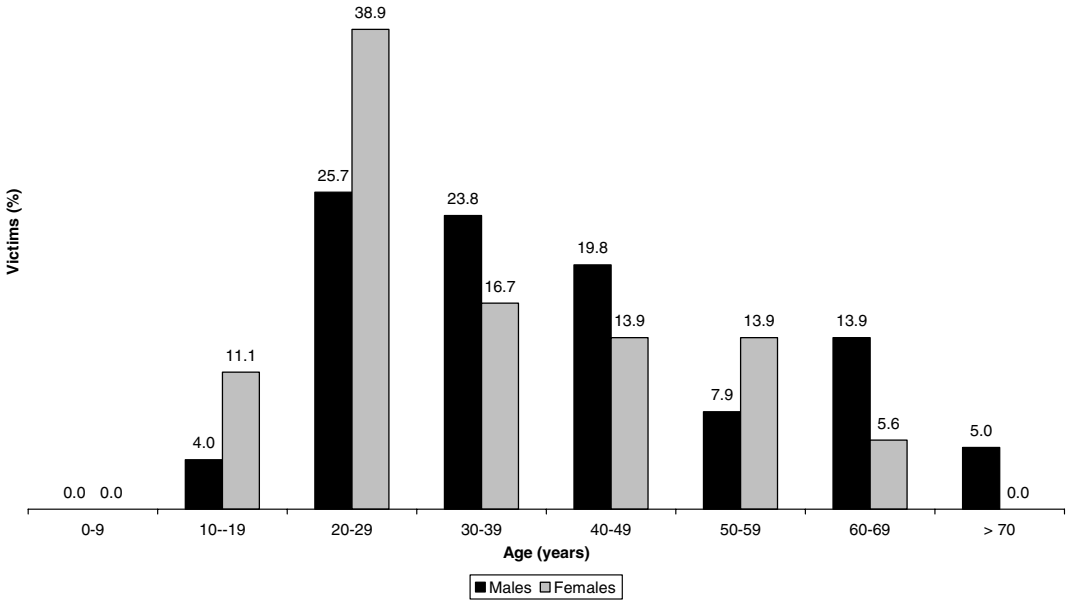

Fig. 1. Age distribution of victims.

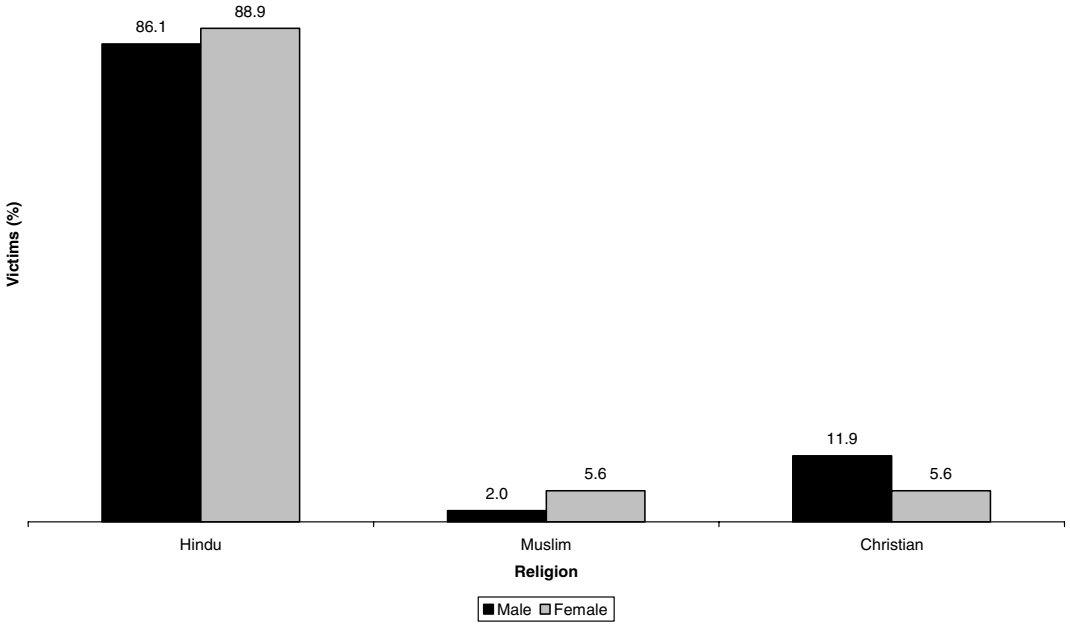

Fig. 2. Religion wise distribution of victims.

to 6 pm), while evening time (6 pm to midnight) was preferred by males. None of the female victim consumed poison during midnight and early morning hours (Fig. 5). Maximum suicidal poisoning deaths among males ($n = 59$) and females ($n = 22$) have been reported in the first half of the year (January–June) with maximum male mortalities occurring during April–June period (30.7%, $n = 31$) and female mortalities during January and March (44.3%, $n = 16$). Month wise distribution of poisoning fatalities is shown in Fig. 6.

A decline in suicidal poisoning was observed during the study period in both sexes. Suicidal poisoning mortalities declined from 28.7% to 11.9% in males and from 25% to 16.7% in females. The decline was more gradual and marked in males (Fig. 7).

4. Discussion

In India, in the year 2000, more than two lakh lives were lost from unnatural causes, of which 23,395 were due to poisoning alone.[5] Ours is a rural set up, where deaths due to poisoning constitute major health problem, and is the second most common cause of unnatural mortalities. Poisoning related mortalities are quite high as compared

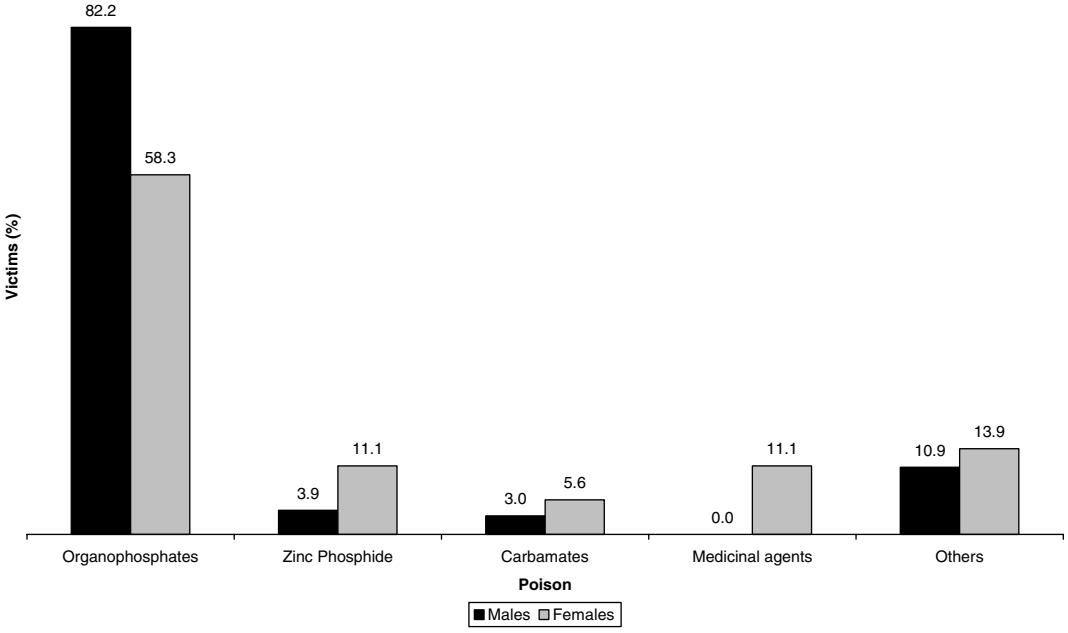

Fig. 3. Choice of poison in suicides among males and females.

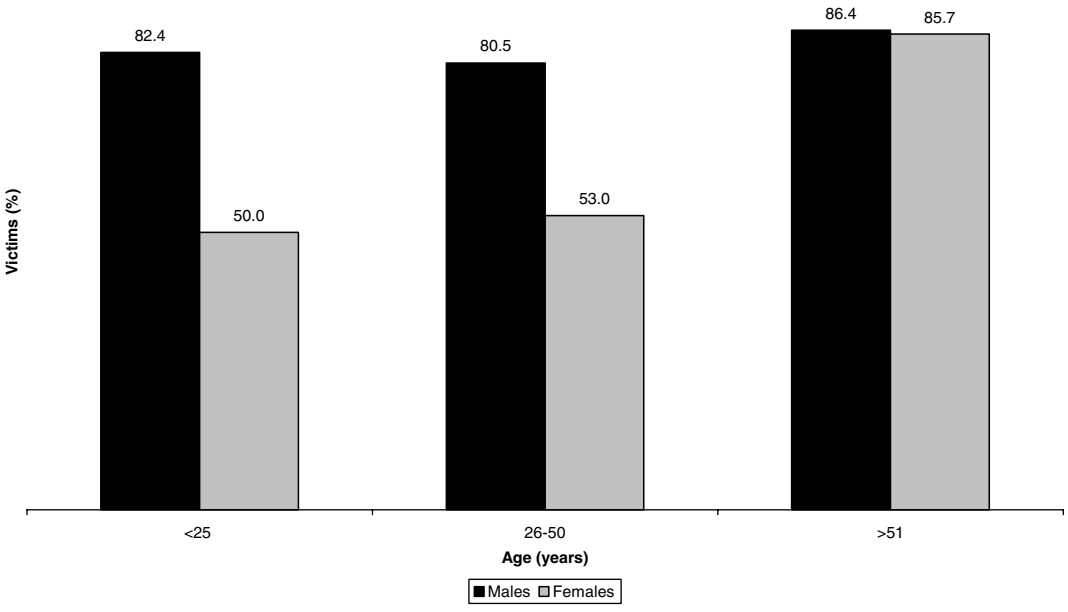

Fig. 4. Choice of organophosphate compounds in different age groups.

to those in other parts of India and abroad. Suicidal poisoning forms a bulk of the total poisoning mortalities.[2] This is attributed to a general belief that poisoning kills with a minimal suffering. Human life is full of stress. Hormones, peer pressure, self-esteem, confusion, self-doubt, expectations, pressure to succeed, academic responsibilities, maladjustment, financial uncertainty and physical diseases are some of the factors contributing to this stress during different age groups. Early marriage in Indian females, formation of a new family and moving to a new household after marriage, demands more adjustments, and can be very unsettling, resulting in increased stress. Suicide is often an impulsive act resulting from the inability to adjust with their surroundings and cope with the stress they are exposed to. In the absence of emotional support and understanding, one may resort to suicide as a solution to ones problem and stress.

Males outnumbered females in our study (M:F= 2.8:1), and that can be attributed to the fact that males are more exposed to hazards of outside world viz. increased stress, strain and financial burden. During the study period, no poisoning mortalities were recorded below 15 years of age. Similar findings have been reported by surveys done in the sub-continent and Europe.[6–8] Although suicidal poi-

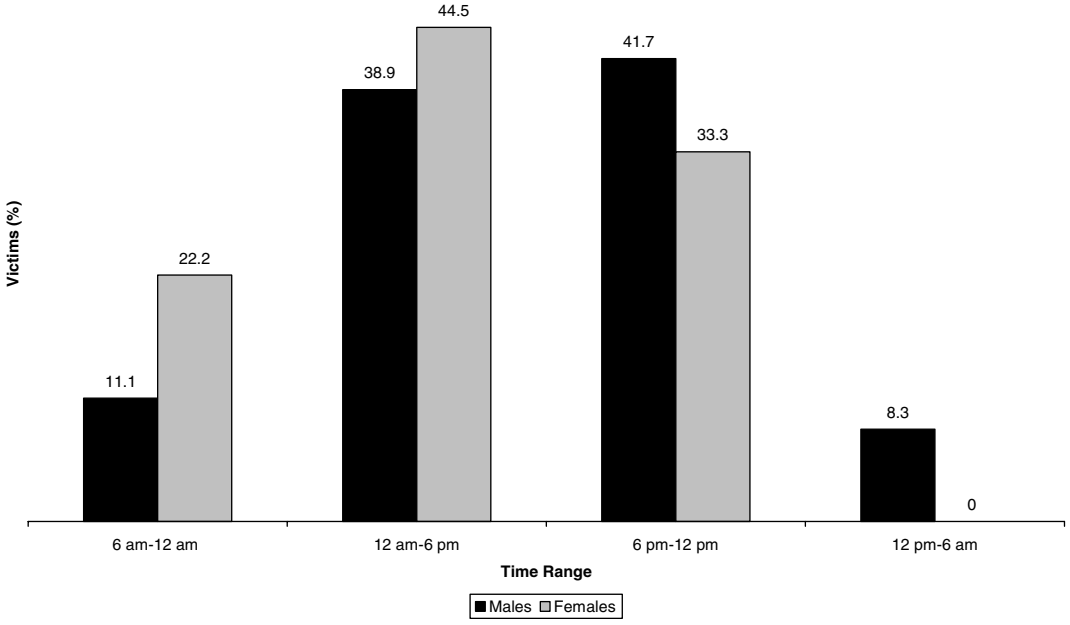

Fig. 5. Time of consumption of poison.

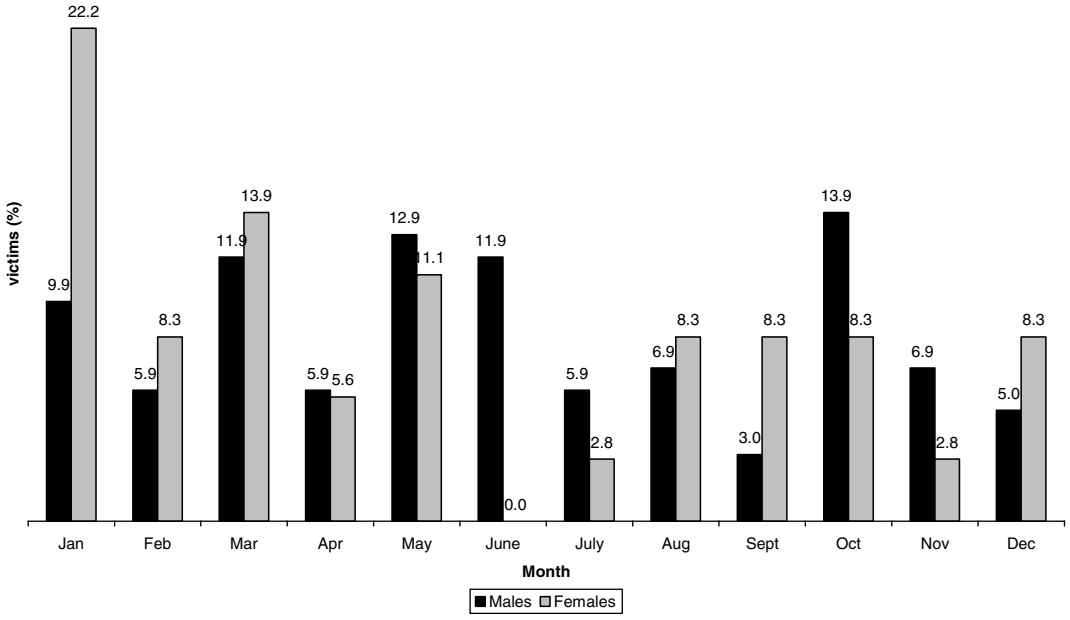

Fig. 6. Month wise distribution of cases.

soning has been reported in all age groups after the age of 15, maximum number of victims were in their 3rd and 4th decade of life among both males and females, for this being the most active phase of life socially, physically and mentally. The peak incidence during 3rd and 4th decades is often attributed to the tremendous stress a person is put to during this period of life. In the Northern Sate of Punjab however, 3rd and 4th decades were most affected age groups in males and 2nd and 3rd decade in females.[9,10] Mean age of female victims was a decade lower in comparison to their male counterparts. On comparative analysis, males in their 4th, 5th, 7th and 8th decades were found to be more prone to suicidal poisoning, whereas 2nd, 3rd and 6th decades were most affected age groups in females.

In females, incidence of suicidal poisoning was quite high and nearly three times that of males in the second decade, similar to a study done in northern India.[10] Suicidal poisoning was relatively more common in young females, where 2nd and 3rd decade together accounting for nearly half of the female mortalities. Female in this age group faces extra stress during and following marriage when she moves to a different place (in-laws house) and is burdened with extra responsibilities. Resulting sudden changes in her lifestyle, where she is expected to adjust well with the new

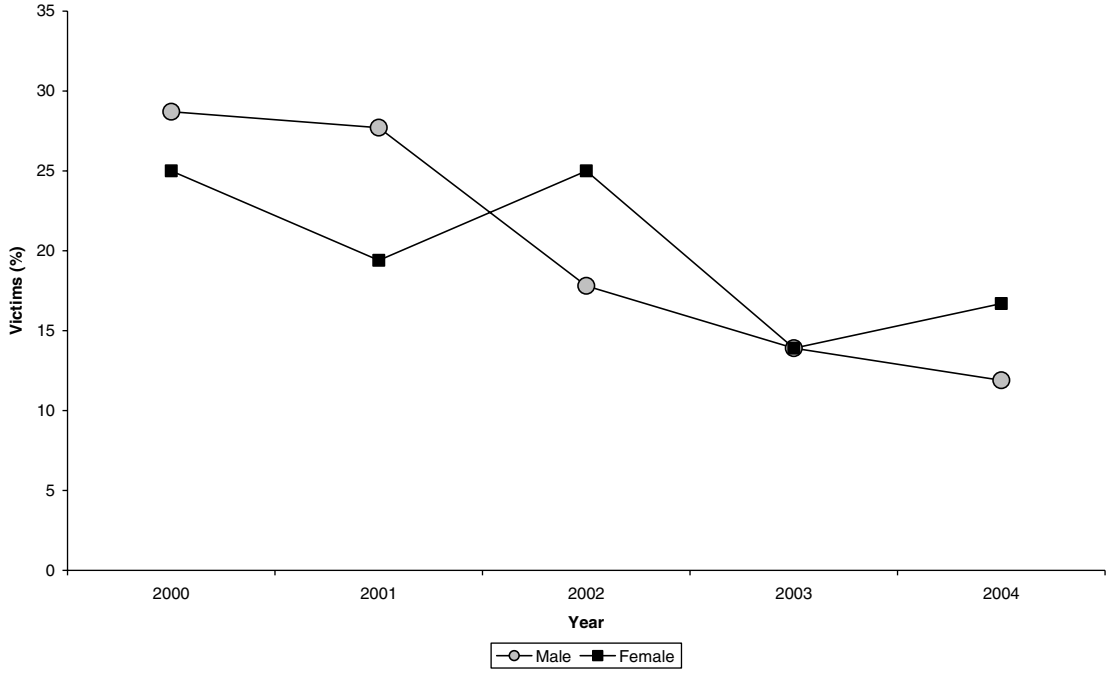

Fig. 7. Trend of suicidal poisoning.

surroundings may be responsible for high rate of suicidal poisoning in this age group. In males, higher rate of suicidal poisoning during the 4th and 5th decade is mainly attributed to the growing financial burden the male is put to during this phase of life.

During later part of life, higher incidence of suicidal poisoning in females aged 50–59 years may be attributed to perimenopausal hormonal changes. Although not clearly proven, studies have shown that women become more vulnerable to depression during perimenopausal period. This is the time when menstrual periods gradually lengthen, becomes less frequent and there is gradual decline in estrogen levels.[11] Female depression often occurs during periods of hormonal perturbation such as prior to menses, immediately after pregnancy as well as during and shortly after menopause. High incidence and severity of depression in females is associated with ovarian hormones estrogen and progesterone. Serotonin's widely recognized role in depression, and the ability of estrogen and progesterone to modulate different aspects of serotonergic function implicate ovarian hormones as a factor underlying depression. However, the mechanisms by which ovarian hormones modulate the central serotonin system, and ultimately mood, are unknown. The raphe nuclei have been suggested as the site of action for ovarian hormone regulation of serotonergic function despite the inability to detect the classic alpha subtype of estrogen receptor in this region. The recent discovery of the beta subtype estrogen and the localization of ER-beta mRNA in the dorsal raphe provide a potential explanation of the interactions between estrogen and serotonergic systems.[12] Higher incidence in males aged more than 60 years can be owed to post retirement life style changes. This is the period when the financial dependability increases and the male is confined to indoors most of the time that he is not accustomed to. These causes of stress are in addition to physical diseases, that they are prone to as the age increases, resulting in depression. Depression is a well recognized risk factor for suicide worldwide. 15.3% of victims (n= 37) were suffering from depression. Percentage of females suffering from depression however was more when compared to males. Only four victims were under medical advice at the time of incident. Lower incidence of depression in suicidal poisoning mortalities, and number of people seeking medical advice, may be owed to reluctance of the people to attend a clinic for simple psychiatric complaints and shortage of trained specialists in the country. Ganju reported that there are about 1500 psychiatrists and 500 clinical psychologists in India, where the population is over a billion.[13]

Hindus constitute around 84% of the regional population, 12% follow Islam and 2% are Christians. Incidence of suicidal poisoning mortalities was very high in Hindus males (86.1%) and females (88.9%). Christian males (11.9%) and Muslim females (5.6%) were more common victims of suicidal poisoning when compared to their counterparts. Hindu and Christian males are predominantly engaged in agriculture related occupations. The fact that farming community is more prone to suicides may be responsible for this high rate of suicidal poisoning among Hindu and Christian males. Suicide is considered '*haram*' and strictly forbidden in Islam, the Muslim religion. This may be the reason for low incidence of suicidal poisoning among Muslims as such.[14,15]

Organophosphates were found to be responsible for maximum mortalities in males and females followed by zinc phosphide (rodenticide) and carbamates. Basic pattern

and trend of poisoning shows a regional variation. The use of certain poisons to commit suicide depends on the availability and accessibility of the agent to an individual. Organophosphates continue to be the most commonly used agrochemicals in southern and western part of the country.[2,3,7] In Northern India however, pesticide aluminium phosphide, a grain preservative is most commonly used.[16,17] Easy availability of these agrochemicals is responsible for the poisoning deaths. Incidence of various poisons among male and female population revealed that choice of poison differs for both sexes. While organophosphates remained the exclusive choice in most of the males (82.2%), females besides organophosphates (58.3) also had a preference for zinc phosphide (11.1%), medicinal agents (11.1%) and carbamates (5.6%). Study in Northern India revealed a similar pattern where, organophosphate poisoning was more common in males, and rodenticides and carbamates in females.[10] Preference for organophosphates amongst males was fairly uniform in all age groups, while females aged more than 51 years, preferred organophosphate compounds as means of suicide. In our study, no suicidal drug overdose was observed among males contrary to a study in Tamilnadu, Southern India where it was a common means of suicidal poisoning in males.[3]

Most of the victims consumed poison during daytime, similar to studies done in Eastern part of the country.[18,19] In a study in Italy, maximum suicidal mortalities were reported during late morning hours.[20] In our study, a diurnal variation in the distribution of suicide was observed for both genders. During day hours, afternoon was preferred by females and evening time by males. This relative preference of time can be attributed to the fact that a person under stress is more prone to depression and ideas of self-destruction when alone and not engaged in other works. Females chose morning hours more frequently, whereas males had a relative preference for late night hours. Choice of such a time is probably to escape attention of others.

Seasonal asymmetry in suicide is a long observed phenomenon and possible association between the monthly and seasonal distribution of completed and attempted suicides have long been studied. Seasonal variations in suicide rates have been reported for many countries, with a spring peak for men and spring and autumn peaks for women.[21,22] Preti and Miotto found evidence for seasonality only in violent suicides, whereas nonviolent suicides showed no seasonal trends.[23] Climatic conditions in this coastal region of Southern India differ from other parts of India and world. Predominant seasons are summers and monsoon, and during most part of the year climatic conditions are hot and humid. Maximum suicides were reported during first half of the year with male mortalities occurring predominantly during second, and females during first quarter of the year. In Eastern part of India, highest number of cases were reported in rainy season,[24] while in Faisalabad, Pakistan a seasonal surge was observed in spring.[25] Month wise distribution of cases saw peak incidence of suicidal poisoning fatalities among males (13.9%) and females (22.2%) in October and January, respectively. The latitude and climatic factors, such as day length, daily temperature, daylight, and humidity may influence mood.[26,27] It has been suggested that seasonal vulnerability is biologically determined and associated with the circannual rhythm of central serotonin neurotransmission.[28]

A declining trend in poisoning fatalities was observed during the study period in both males and females. This overall decline in the incidence of suicidal poisoning during the past five years, in males was gradual and marked when compared to females. This may be indicative of effectiveness of ongoing preventive measures taken up by the authorities.

5. Conclusions

Male–female profile of suicidal poisoning differs with regard to different variables analysed. The study highlights the gender differences in suicidal poisoning mortalities in Manipal, Southern India, and reveals that:

- Suicidal poisoning fatalities amounted for 17.9% of the total autopsied cases. Males were more common victims, male–female ratio being 2.8:1.
- Males and females in their third decade were most prone to suicidal poisoning. Suicidal poisoning was encountered at a younger age in females when compared to males. Adolescent females and elderly males formed the most vulnerable groups.
- Depression as a risk factor for suicidal poisoning was more common in females.
- Organophosphates were the poison of choice, responsible for 82.2% male and 58.3% female fatalities. Suicidal poisoning with rodenticides (zinc phosphide) and carbamates was more common among females.
- Males were particularly vulnerable to suicidal poisoning during late evening and night hours, and females during morning and afternoon hours. Seasonal asymmetry is observed with maximum male mortalities occurring during premonsoon and female mortalities during summer months.

A number of chemicals, developed for the benefit of humans, are being used as means of self-destruction, which is a cause of concern. Strict implementation and enforcement of laws, greater control in the sale and use of these products, stress management to decrease the stress of modern mechanical life style, general and marriage counseling are recommended along with better health care facilities in rural India, to prevent these suicidal poisoning mortalities. Although the study may help in defining the target population separately among males and females, there is a need for prospective studies into the gender differences in underlying risk factors of suicidal poisonings in different age groups. The influence of depression on suicides in Southern India is a subject of further research.

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